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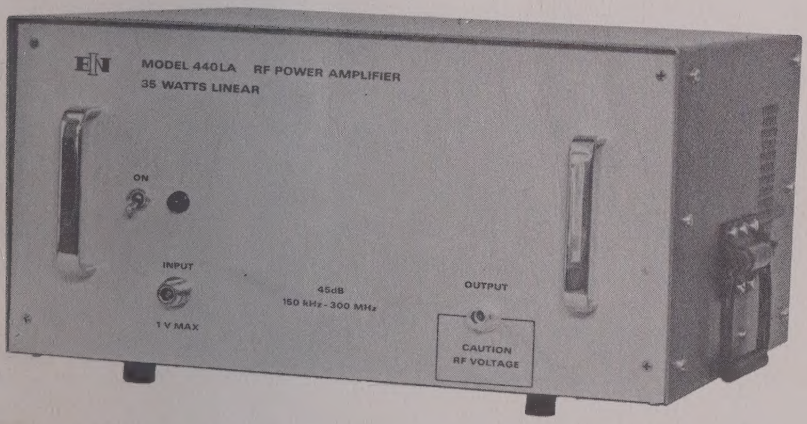
ELECTRONIC NAVIGATION INDUSTRIES, INC.

INSTRUCTION MANUAL

MODEL 440LA

BROADBAND POWER AMPLIFIER



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WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If, in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started.

There are no other warranties expressed or implied, including any warranty of merchantibility or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

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CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

The Model 440LA is a general purpose broadband amplifier capable of more than 35 watts of linear power output when driven by any laboratory signal or sweep generator from .15 to 300 MHz.

An ultra linear Class A design, the 440LA will "boost" the output of any signal source by a flat 45 dB (±1.5 dB) and provide its full forward output power into any load impedance (from an open to a short circuit). Its output is a faithful reproduction of the input waveform for AM, FM, SSB, CATV, pulse and other complex modulations. Although specified only over the .15 to 300 MHz frequency range, full power output is typically available from .12 to 310 MHz.

The microwave transistors on thin film substrates, microstrip circuitry, and plug-in modules make the 440LA both reliable and easy to service. An integral power supply and cooling system permit operation over a wide range of temperature and AC line conditions.

1.2 DATA SUMMARY

Frequency Coverage:	.15 to 300 MHz
Gain:	45 dB nominal
Gain Variation:	±1.5 dB
Maximum Linear Power Output:	More than 35 watts
Harmonic Distortion:	All harmonics greater than 25 dB below the fundamental at 35 watts output. Lower distortion at reduced power.
Input/Output Impedance:	50 ohms
Input VSWR:	1.4 Maximum
Output VSWR:	2.0 Maximum
Stability:	Unconditionally stable

2.2.3 Mains Lead Connection

For 230V a.c. operation, a suitable mains supply plug must be fitted to the mains lead attached to the instrument. The three conductors are coded as follows:

BLACK - Live
WHITE - Neutral
GREEN - Earth

2.3 OPERATION

Determine and adjust the voltage setting and fuse rating as described in the previous sections 2.2.1 and 2.2.2 then proceed as follows:

(i) Ensure input voltage is not excessive

The 1 V rms indicated maximum input voltage is 5 times the level of the input signal required to achieve maximum output. Input voltages in excess of 2 volts peak may permanently damage the instrument.

(ii) Connect the input signal via a 50 ohm coaxial lead to the input connector.

(iii) Connect the output via a 50 ohm coaxial lead to the load.

CHAPTER 3 TECHNICAL DESCRIPTION

3.1 GENERAL DESCRIPTION

The ENI Model 440LA is designed to amplify signals by 45 dB in the frequency band of .15 to 300 MHz. The signal from the front panel type "N" connector is fed via a length of 50 ohm coaxial cable to the input of the preamplifier module (440LA-3741). See figures 5.1 and 5.2. The signal is attenuated and impedance matched by R1, R2, R3, and amplified by low noise transistors Q1 and Q2. The output at the collector of Q2 is matched and split into four equal phase and amplitude signals by transformers T1, T2, T3, and T4. Each of the four drive channels is coupled to a final transistor amplifier Q3, Q4, Q5, and Q6. The outputs of each transistor are combined by T5, T6, and T7. Transformer T8 splits the output of the preamplifier into two equal phase and amplitude signals appearing at J3 and J4. These signals are distributed by 50 ohm coaxial cables and two eight-way splitters (440LA-4744) to form the inputs to sixteen identical power amplifier modules (400AP-4641) mounted on two "U" shaped RF heatsinks.

At each power amplifier module the input signal is matched and attenuated by resistors R1, R2, R3, and capacitor C1 and coupled to the base of transistor Q1. The output of the collector of Q1 is matched and split into four equal phase and amplitude signals by transformers T1, T2, T3, and T4. Each of the four drive channels is coupled to a final transistor amplifier (Q2, Q3, Q4, and Q5). The outputs of each transistor are combined and impedance matched at the output jack by transformers T5, T6, T7, and T8.

The outputs of the sixteen power amplifier modules are distributed to four, four-way combiners (440LA-4743) via 50 ohm coaxial cables of equal length. Four of the amplifier module outputs are combined in each four-way combiner by T2, T3, and T4 and matched by T1 to form one 50 ohm output.

The outputs from the four (440LA-4743) combiner modules are then fed via 50 ohm coaxial cables to the inputs of the output combiner module (440LA-4742). Hybrid transformers T3, T4, and T2 vectorially sum the power outputs of the four four-way combiner modules. Transformer T1 and capacitor C1 match the output impedance of the combiner to 50 ohms. Resistors R1, R2, and R3 will dissipate power only if the power amplifiers are unmatched or a failure has occurred. The output of the combiner module is sent to the output type "N" connector on the front panel via a length of coaxial cable.

Regulated D.C. power is supplied by two power supplies working independently of each other, the 440LA-3744 which provides a regulated 22 VDC, 8 ampere source and the 440LA-3745 which provides a regulated 22 VDC, 9 ampere source. In both cases the 22 VDC sources are regulated by series pass transistors driven by transistor Q1 in a Darlington arrangement. Voltage control and feedback are provided by integrated circuit regulator IC1 in both sources. Each power supply voltage is adjusted to 22 VDC by R7 on the respective regulator board (440LA-4745). R5 on each regulator board adjusts the short circuit load current to 10 amperes thereby protecting the power supply from over-dissipation.

CHAPTER 4 MAINTENANCE

4.1 INTRODUCTION

The ENI 440LA RF amplifier requires no periodic maintenance. The instrument is unconditionally stable and is failsafe under all load conditions. Damage can only be externally caused by the incorrect selection of the supply voltage or by an input signal in excess of the specified 1 volt rms maximum.

This chapter therefore, deals only with certain fundamental procedures for fault location and with the subsequent re-alignment procedures.

Performance limits quoted are for guidance only and should not be taken for guaranteed performance specifications unless they are also quoted in the Data Summary Section 1.2.

4.2 ACCESS AND LAYOUT

The ENI Model 440LA is housed in an aluminum chassis. The cover may be removed by releasing the eight screws on each side of the unit.

The lamp indicator on the front panel may be replaced by unscrewing the lens cover and removing the lamp.

The rear panel supports the mains fuse holder, the mains input voltage selector switch (S2) and the cooling fans.

The preamplifier module is attached to the front panel mounting bracket. To gain access to the module first remove the associated coaxial cables and input power connection. Unscrew the three screws holding the module to the mounting bracket.

Eight power amplifier modules, a power supply regulator board, an eight-way splitter and two four-way combiner modules comprise one of the two "U" shaped RF heatsink assemblies incorporated in the 440LA. To gain access to either of these heatsink assemblies first remove all of the associated coaxial cables and the eight #4-40 mounting screws holding the heatsink to the chassis. The eight-way splitter and power supply regulator boards are located on the inside of each RF heatsink. To adjust each of the 22VDC power supplies lift the snap plug at the top rear of the RF heatsink over the supply to be adjusted. This will expose the voltage adjust potentiometer (R7).

There are two power supply transistor assemblies in the 440LA, each one acting independently of the other. They are mounted with four #4-40 screws, one transistor module under each RF heatsink.

The output combiner module is mounted in the same fashion as the preamplifier module on the adjacent front panel mounting bracket.

4.3 PERFORMANCE CHECKS

To determine the amplifier's performance carry out the following procedure.

4.3.1 Initial Check

The following check can be made after repair and adjustments or whenever the condition of the unit is in question.

(i) Connect power supply. Switch on power and observe that the supply lamp (DS1) illuminates.

(ii) Connect a sweep generator (Wavetek 2001 or similar) capable of sweeping the frequency range 1 to 300 MHz to the input connector.

(iii) Adjust the output level of the sweep generator so that a 50 ohm video detector connected at the output of the unit will not be damaged by excessive power output.

(iv) Observe the gain versus frequency ripple on an oscilloscope calibrated in decibels. The gain variation must be not more than ± 1.5 dB over the frequency range.

(v) Connect a calorimetric power meter (HP434 or equivalent) through a short length of 50 ohm cable to the output connector. Adjust the input CW signal to any frequency between 1 and 300 MHz for 35 watts output.

(vi) Observe the harmonic distortion of the output on a spectrum analyzer. The harmonic components contributed by the amplifier should be at least 25 dB down from the fundamental.

If the requirements of this check are not met, verify that:

(a) The mains supply switch and fuse are correctly selected and that DS1 is illuminated.

(b) The preamplifier and power amplifier voltages are set for 22 VDC by R7 on each regulator module.

If the above checks are found to be correct, then normal fault location procedures, with reference to the circuit diagram Figure 5.1 and 5.2 should be followed to determine the correct operation of the preamplifier and power amplifier modules.

4.4 RE-ALIGNMENT PROCEDURE

Before any adjustment is made to the unit, first

(i) Ensure that the mains switch and fuse are correctly selected and that DS1 is illuminated.

(ii) Measure the power supply voltages and adjust per section 4.3.1(b).

4.4.1 Measurement of Gain

Equipment required:

(a) Oscilloscope - Telequipment Model S54A
(b) Sweep/Signal Generator - Wavetek 2001
(c) 50 ohm Detector - Wavetek D151
(d) Attenuator, 10 dB, 20 watts - Narda 766-10
(e) Sweep/Signal Generator-HP8601A

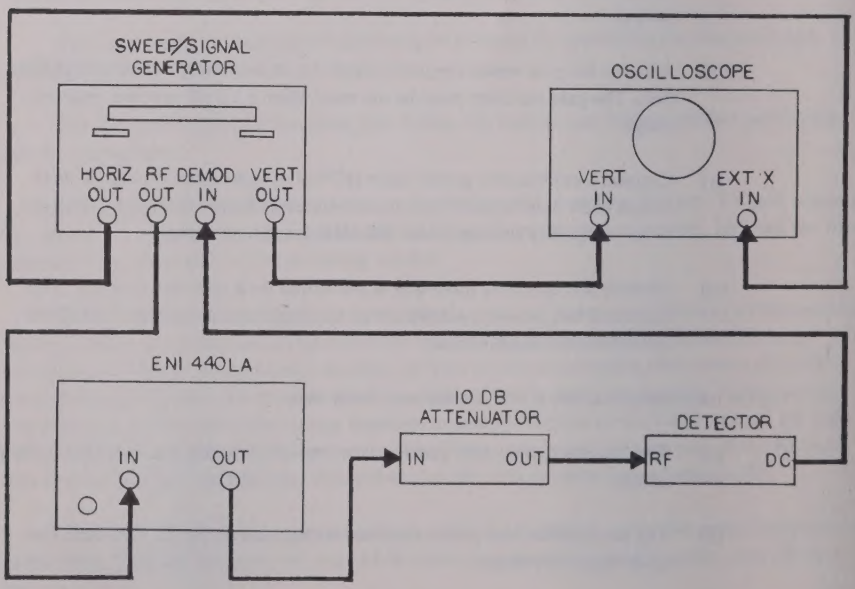

Figure 4.1 Gain Measurement

Connect the equipment as shown in Figure 4.1, then proceed as follows:

(a) Set the oscilloscope to DC, time/CM to Ext. X., and vertical gain to 10MV/CM.

(b) Set the sweep/generator to the S/S mode with the start frequency at 1 MHz and the stop frequency at 300 MHz.

(c) Disconnect the ENI 440LA from the set-up and connect the sweep/generator RF output directly to the 10 dB attenuator.

(d) Adjust the output level of the sweep/generator for full vertical deflection on the oscilloscope face.

(e) Calibrate the scope face to show 3 dB in 1 dB steps by attenuating the sweep/generator in 1 dB steps and marking the traces with a grease pencil.

(f) Return sweep/generator output level to full deflection. Rotate the step attenuator on the sweep/generator (CCW) so that the output is reduced by 45 dB.

(g) Reconnect the 440LA into the test set-up of Figure 4.1.

(h) Push the 440LA power switch to the "on" position.

(i) Observe the gain versus frequency sweep on the oscilloscope. Adjust the output of sweep/signal generator so that trace is centered.

1. The average gain should be 45 dB (within 1.5 dB).

2. The gain variation should be within the 3 dB markings as shown on the oscilloscope.

(j) If the gain versus frequency sweep is out of specification, adjust R7 located in each power supply regulator module ($\pm$.5V max) until the sweep observed on the oscilloscope is within the 3 dB markings.

(k) Repeat steps (a) through (j) using the HP8601A sweep generator with start frequency at 150 kHz and stop frequency at 1 MHz.

4.4.2 Measurement of Harmonics

Equipment required:

(a) Sweep/Signal generator - Wavetek 2001
(b) Attenuator, 30 dB-Bird 8321
(c) Calorimetric Power Meter-HP434A

(d) Spectrum Analyzer - HP140T Display Unit
HP8554L Spectrum Analyzer
RF Section
HP8552A Spectrum Analyzer
IF Section

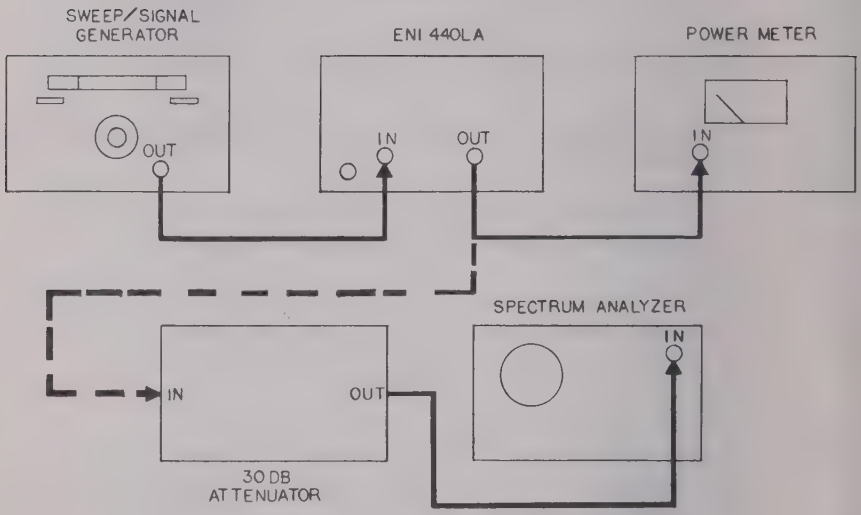

Figure 4.2 Harmonic Measurement

Connect the equipment as shown in Figure 4.2 then proceed as follows:

(a) Adjust the sweep/signal generator at a CW center frequency of 150 MHz for an indicated output of 35 watts on the power meter.

(b) Using the spectrum analyzer, check that the level of the carrier harmonics are less than -25 dB with respect to the carrier.

(c) If the above specification is not met, the 22 volt d.c. supplies may be varied up to $\pm$.5V to reduce the harmonic level.

4.5 PACKAGING FOR RESHIPMENT

In the event of the equipment being returned for servicing it should be packed in the original shipping carton and packing material. If this is not available wrap the instrument in heavy paper or plastic and place in a rigid outer box of wood, fiberboard or very strong corrugated cardboard. Use ample soft packing to prevent movement. Provide additional support for projecting parts to relieve these of unnecessary shock. Close the carton securely and seal with durable tape. Mark the shipping container FRAGILE to ensure careful handling.

CHAPTER 5 SCHEMATIC AND PARTS LIST

5.1 SCHEMATIC DIAGRAM

A complete schematic diagram appears in figure 5.1 and 5.2.

5.2 PARTS LIST

Table 5.1 provides a listing of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagrams. Parts list includes a description, part number and manufacturers federal supply code number. Table 5.2 provides a reference glossary of abbreviations used in the parts list.

5.3 LIST OF MANUFACTURERS

Table 5.3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code number (10226) appears, that part must be obtained directly from Electronic Navigation Industries, Inc.

5.4 ORDERING REPLACEMENT PARTS

To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc. or its authorized service facility. Identify parts by number as listed in the parts list.

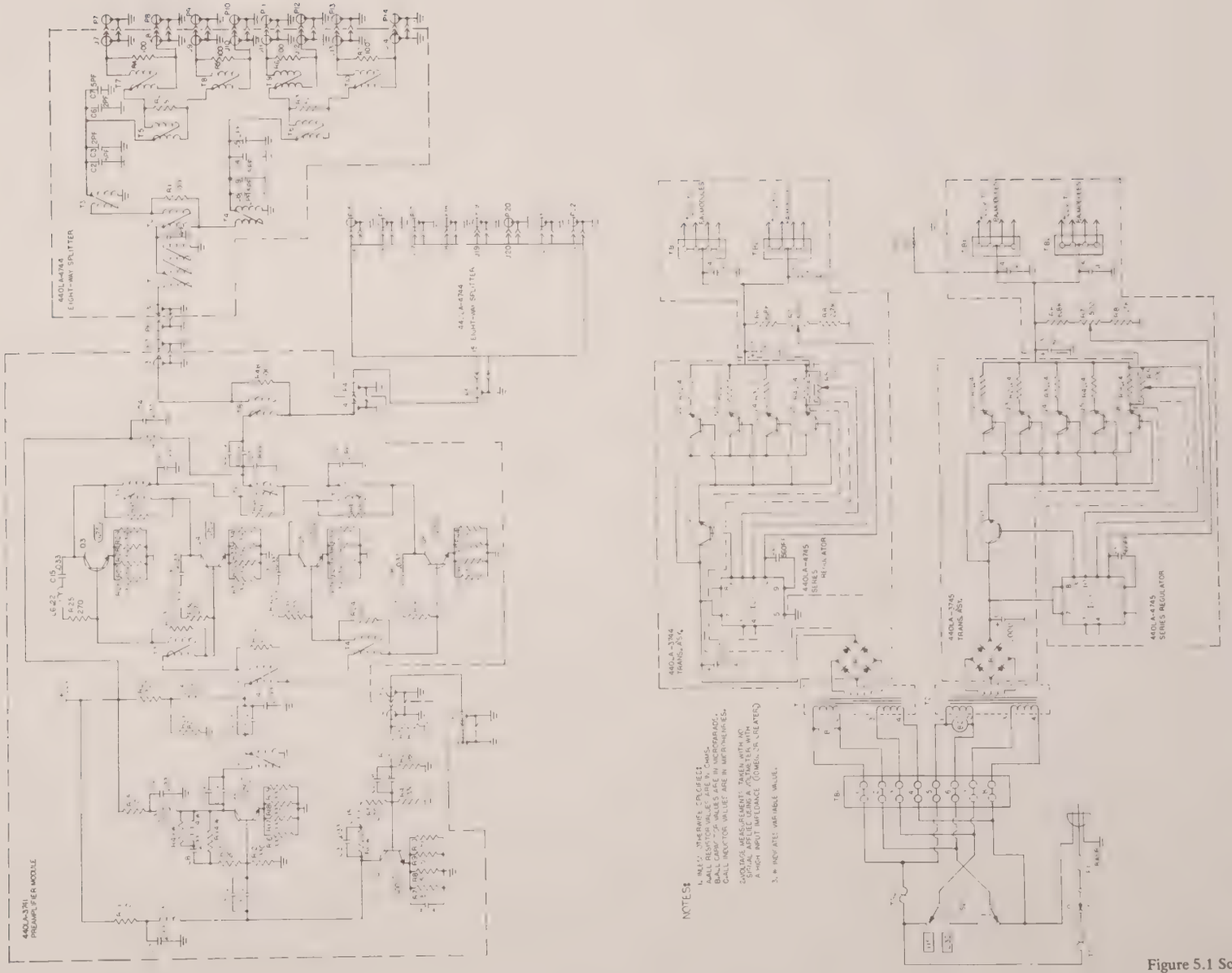

Figure 5.1 Schematic Diagram

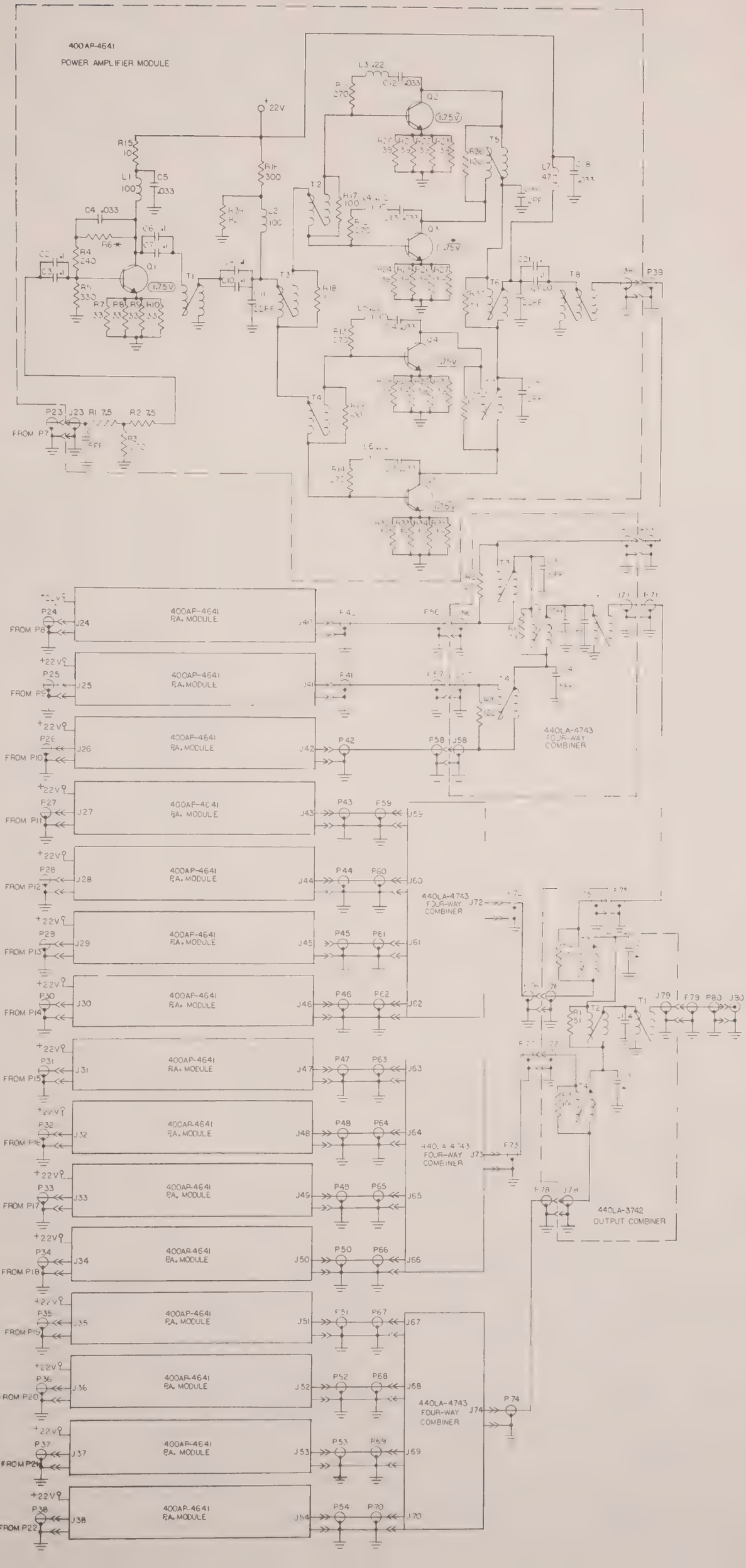

Figure 5.2 Schematic Diagram

TABLE 5.1. REPLACEMENT PARTS LIST
MODEL 440LA

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
	POWER DISTRIBUTION ASSEMBLY		
CR1	Bridge Rectifier	04713	MDA990-2
C1	Cap.,Elect. 12000 UF 40VDCW	56289	36D123G040BC2A
Q1	Transistor	79089	40312
Q2-Q6	Transistor	84411	2N3772
R1-R4,R9	Resistor, WW, .24 ohm 5% 2W	75052	BWH .24
T1,T2	Transformer, Power	12715	AM8059
S1	Switch	27191	7361K5
DS1	Lamp,28VDC - 40 MA	72619	101-8430-0931-201
J1	Jack, Type N	13511	UG-680/U
J80	Jack, Type N to BNC	91836	UG-606/U
B1,B2	Fan	28875	WS2107FL
S2	Switch, Slide DPDT	22753	622-HK-115/230
F1	Fuse Type 3AG-8ASB	75915	313008
XF1	Fuseholder	75915	342001
TS1,TS2	Thermal Switch	14604	2450-88-105
	DRIVER ASSEMBLY	10226	440LA-3741
Q1	Transistor	84411	LT2001
Q2-Q6	Transistor	10226	CD2240
A-102	Driver Board	10226	440LA-4741
A102R1	Resistor,Comp. 27 ohm 5% 1/8W	01121	RC05GF270J
A102R2,R3	Resistor,Comp. 180 ohm 5% 1/8W	01121	RC05GF181J
A102R4	Resistor,Comp. 330 ohm 5% 1/4W	01121	RC07GF331J
A102R5	Resistor,Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
A102R6	Resistor,Comp. Variable	01121	
A102R7-R10	Resistor,Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
A102R11	Resistor,Comp. 100 ohm 5% 1W	01121	RC32GF151J
A102R12	Resistor,Comp. 330 ohm 5% 1/4W	01121	RC07GF331J
A102R13	Resistor,Comp. 200 ohm 5% 1/2W	01121	RC20GF241J
A102R14	Resistor,Comp. Variable	01121	
A102R15	Resistor,Comp. 10 ohm 5% 1W	01121	RC32GF100J
A102R16-R19	Resistor,Comp. 33 ohm 5% 1/4W	01121	RC07GF330J
A102R20	Resistor,Comp. 300 ohm 5% 2W	01121	RC42GF301J
A102R21	Resistor,Comp. 82 ohm 5% 1/2W	01121	RC20GF820J
A102R22	Resistor,Comp. 51 ohm 5% 1/4W	01121	RC07GF510J

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
	DRIVER ASSEMBLY (cont.)		
A102R23,R24	Resistor,Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A102R25	Resistor,Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
A102R26-R29	Resistor,Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
A102R30	Resistor,Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
A102R31-R34	Resistor,Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
A102R35	Resistor,Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
R102R36-R39	Resistor,Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
A102R40	Resistor,Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
A102R41-R44	Resistor,Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
A102R45	Resistor,Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A102R46	Resistor,Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
A102R47,R48	Resistor,Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A102R49	Resistor,Comp. Variable	01121	
A102C1,C2	Cap.,Cer.,.1UF 50VDCW	72982	8131-050-651-104Z
A102C3	Cap.,Cer.,.033UF 50VDCW	72982	8121-050-651-333Z
A102C4	Variable		
A102C5,C6	Cap.,Cer.,.1UF 50VDCW	72982	8131-050-651-104Z
A102C7-C9	Cap.,Cer.,.033UF 50VDCW	72982	8121-050-651-333Z
A102C10-C13	Cap.,Cer.,.1UF VDCW	72982	8131-050-651-104Z
A102C14	Cap.,Mica,22PF, 5%	09023	CM05ED220J03
A102C15-C18	Cap.,Cer.,.033UF 50VDCW	72982	8121-050-651-333Z
A102C19	Cap.,Mica,2PF, 5%	09023	DM5CC050A
A102C20,C21	Cap.,Cer.,.1UF 50VDCW	72982	8131-050-651-104Z
A102C22	Cap.,Mica,2PF, 5%	09023	DM5CC050A
A102C23	Cap.,Mica,18 PF, 5%	09023	CM05ED180503
A102C24	Cap.,Cer.,.033UF 50VDCW	72982	8121-050-651-333Z
A102L1	Choke,RF., .15UH	99800	MSI8I30-1
A102L2	Choke,RF	10226	
A102L3	Choke,RF, 100UH	99800	2890-42
A102L4	Choke, Variable		
A102L5	Choke,RF, 100UH	99800	2890-42
A102L6-L9	Choke,RF, .22UH	99800	1025-04
A102L10	Choke,RF, 47UH	99800	2890-36
A102T1-T7	Transformer	10226	
A102T8	Transformer	10226	
	OUTPUT COMBINER ASSEMBLY	10226	440LA-3742
A103	Output Combiner Board	10226	440LA-4742
A103R1	Resistor,Power, 50 ohm, 50W	13327	MR250-875
A13R2,R3	Resistor,Power, 100 ohm, 50W	13327	MR250-875

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
	OUTPUT COMBINER ASSEMBLY (cont.)		
A103C1	Capacitor, Variable		
A103C2,C3	Capacitor, Variable		
A103T1	Transformer	10226	
A103T2	Transformer	10226	
A103T3,T4	Transformer	10226	
	P.A. HEATSINK ASSEMBLY	10226	440LA-3743
A105	4-Way Combiner Board	10226	440LA-4743
A105R1	Resistor,Comp., 51 ohm 5% 1/2W	01121	RC20GF510J
A105R2,R3	Resistor,Comp., 120 ohm 5% 1/2W	01121	RC20GF121J
A105C1,C2	Cap., Mica, 10 pf 5%	09023	DM5CC100A
A105C3,C4	Cap., Mica, 5 pf, 5%	09023	DM5CC050A
A105T1	Transformer	10226	
A105T2	Transformer	10226	
A105T3,T4	Transformer	10226	
A104	8-Way Splitter Board	10226	440LA-4744
A104R1	Resistor, Comp., 100 ohm 5% 1/4W	01121	RC07GF101J
A104R2,R3	Resistor, Comp., 51 ohm, 5% 1/4W	01121	RC07GF510J
A104R4-R7	Resistor, Comp., 100 ohm, 5% 1/4W	01121	RC07GF101J
A104C1	Cap., Mica, 4pf 5%	09023	DM5CC040A
A104C2	Cap., Mica, 5pf 5%	09023	DM5CC050A
A104C3	Cap., Mica, 2pf 5%	09023	DM5CC020A
A104C4	Cap., Mica, 5pf 5%	09023	DM5CC050A
A104C5	Cap., Mica, 2pf 5%	09023	DM5CC020A
A104C6	Cap., Mica, 2pf 5%	09023	DM5CC020A
A104C7	Cap., Mica, 5pf 5%	09023	DM5CC050A
A104C8	Cap., Mica, 2pf 5%	09023	DM5CC020A
A104C9	Cap., Mica, 5pf 5%	09023	DM5CC050A
A104T1	Transformer	10226	
A104T2	Transformer	10226	
A104T3,T4	Transformer	10226	
A104T5-T10	Transformer	10226	
A106	P.S. regulator board	10226	440LA-4745
A106R5	Pot, 200 ohm 5%	32997	3389T-1-201
A106R6	Resistor, film 6.8K ohm 5% 1/2W	16299	HC5-6.8K
A106R7	Pot, 500 ohm 5%	32997	3389T-1-501
A106R8	Resistor, Film 2.7K ohm 5% 1/2W	16299	HC5-2.7K
A106C2	Cap., Mica, 560pf 5%	09023	CM05ED561J03
A106C3	Cap., Elect., 50UF 50VDCW	56289	500D506G050DD7
A106C4,C5	Cap., Cer.,.1UF 50VDCW	72982	8131-050-651-104Z

REF. DESIGN	DESCRIPTION	MFG. CODE	PART NO.
A106IC1	I.C.Regulator	44956	RC723CT
A88	Power Amplifier Board	10226	400AP-4641
A88R1,R2	Resistor, Comp. 7.5 ohm 5% 1/4W	01121	RC07GF7R5J
A88R3	Resistor, Comp. 200 ohm 5% 1/4W	01121	RC07GF201J
	P.A. HEATSINK ASSEMBLY (cont.)		
A88R4	Resistor, Comp. 240 ohm 5% 1/2W	01121	RC20GF241J
A88R5	Resistor, Comp. 330 ohm 5% 1/4W	01121	RC07GF331J
A88R6	Resistor, Comp. Variable	01121	
A88R7-R10	Resistor, Comp. 33 ohm 5% 1/4W	01121	RC07GF330J
A88R11-R14	Resistor, Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
A88R15	Resistor, Comp. 10 ohm 5% 1W	01121	RC32GF100J
A88R16	Resistor, Comp. 300 ohm 5% 2W	01121	RC42GF301J
A88R17	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A88R18	Resistor, Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
A88R19	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A88R20-R35	Resistor, Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
A88R36	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A88R37	Resistor, Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
A88R38	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
A88R39	Resistor, Comp. 82 ohm 5% 1/2W	01121	RC20GF820J
A88C1	Cap., Mica, 5pf 5%	09023	RD5CC050A
A88C2,C3	Cap.,Cer., .1UF 50VDCW	72982	8131-050-651-104Z
A88C4	Cap.,Cer., .033UF 50VDCW	72982	8121-050-651-333Z
A88C6,C7	Cap.,Cer., .1UF 50VDCW	72982	8131-050-651-104Z
A88C8	Cap.,Cer., .033UF 50VDCW	72982	8121-050-651-333Z
A88C9,C10	Cap.,Cer., .1UF 50VDCW	72982	8131-050-651-104Z
A88C11	Cap.,Mica, 22PF 5%	09023	CM05ED220J03
A88C12-C15	Cap.,Cer., .033UF 50VDCW	72982	8121-050-651-333Z
A88C16,C17	Cap.,Mica, 2PF, 5%	09023	DM5CC020A
A88C18	Cap.,Cer., .033UF 50VDCW	72982	8121-050-651-333Z
A88C19	Cap.,Mica, 22PF 5%	09023	CM05ED270J03
A88C20,C21	Cap.,Cer., .1UF 50VDCW	72982	8131-050-651-104Z
A88L1,L2	Choke,RF, 100UH	99800	2890-42
A88L3-L6	Choke,RF, .22UH	99800	1025-04
A88L7	Choke,RF, 47UH	99800	2890-36
A88T1-T7	Transformer	10226	
A88T8	Transformer	10226	
A88Q1-Q5	Transformer	10226	CD2240

TABLE 5.2 GLOSSARY OF ABBREVIATIONS

AMP	AMPERES	PF	PICOFARAD
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
CER	CERAMIC	SIL	SILICON
COMP	COMPOSITION CARBON	UF	MICROFARADS
DPDT	DOUBLE-POLE THROW	UH	MICROHENRY
ELECT	ELECTROLYTIC	V	VOLTS
IN	INCHES	VAR	VARIABLE
K	KILOHMS	VDCW	DC WORKING VOLTS
MTG	MOUNTING	W	WATTS
MW	MILLIWATTS	WW	WIRE WOUND

TABLE 5.3 LIST OF MANUFACTURERS

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
01121	Allen-Bradley Co.	Milwaukee, WI.
04713	Motorola, Inc. Semiconductor Prod. Div.	Phoenix, AZ.
09023	Cornell-Dubilier Electronics	Sanford, N.C.
10226	ELECTRONIC NAVIGATION INDUSTRIES, INC.	Rochester, N.Y.
12715	American Magnetics Corp.	Carterville, IL.
13511	Amphenol Corp. Inc.	Los Gatos, CA.
14604	Elmwood Sensors, Inc.	Cranton, R.I.
16299	Corning Glass	Raleigh, N.C.
22753	U I D Electronics Corp.	Hollywood, FL.
32997	Bourns, Inc.	Riverside, CA.
49956	Raytheon Co.	Lexington, MA.
56289	Sprague Electric Co.	N. Adams, MA.
72982	Erie Technological Products, Inc.	Erie, PA.
75042	I R C Div. of TRW, Inc.	Philadelphia, PA.
75915	Littlefuse, Inc.	Des Plaines, IL.
79089	RCA	Harrison, N.Y.
99800	Delevan Electronics Corp.	E. Aurora, N.Y.
72619	Dialight Corp.	Brooklyn, N.Y.
28875	IMC Magnetics	Rochester, N.H.
32159	West-Cap Arizona	Tucson, AZ.
71590	Centralab Electronics	Milwaukee, WI.
83003	Varo, Inc.	Garland, TX.
87034	Marco Oak Industries	Anaheim, CA.
91293	Johanson Manufacturing Co.	Boonton, N.J.

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FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.